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There appears to be reason to believe that the color of the hair is due to an oily pigment, and that this is increased under the influence of Jaborandi.

Shaving the scalp usually has the effect of making the hair thicker and darker, on the contrary, as age advances and the processes of nutrition are enfeebled, the hair becomes thin and dry and whitens.

THE CONSTITUTION OF THE "ATOM" OF SCIENCE.*

By MRS. A. B. BLACKWELL, SOMERVILLE, N. J.

[Abstract.]

This paper developed the hypothesis that in each atom of matter a given quantity of force and extension are conditioned by each other to act in special modes, rigidly adjusted in time and space. All atoms react against many opposed and unlike forces simultaneously, hence each atom must be a highly complex (not compound), elastic structure, which, by its changes in space, gives the direction, extent, rate of vibration, and all modes and transformations of the atomic force.

We can explain this variety and change of action, if we suppose every atom to alternately expand and contract unlike filaments or poles that act and react in vibrations towards and from a common axis, which is at rest. No point outside this axis can be at rest, except when held in equilibrium by other atoms. Reaction is equal and opposite between every part of the atom, and between it and all other atoms. Chemical combination is the interlocking, the literal intertwisting of certain poles of the combining atoms. Such combination brings to rest, makes latent, the opposed combining poles, wholly or in part; the more completely this is done the greater the transformed motion called heat, and the more stable the compound.

In combining, the uniting poles are massed or knotted, as any intertwisting cords would be, and many-atomed molecules require no extra room for their vibrations; but all gases contain equal numbers of molecules to the volume. But the atomic axes are shifted to a common centre; and thus the vibrations of all the free poles are more or less modified, according to the number and kind of the combining factors; they are always so far modified that the molecules of any compound vapor cannot repel those of either of its constituents, nor those of any unlike vapor—the explanation being that the periods of greatest expansion, the stretch outwards in their free poles are not synchronous. In like molecules they are synchronous, and the free poles, striking at any point short of greatest expansion, drive the atoms asunder. We call them mutually repellant. The action of all repulsive forces will admit of similar explanation. Push or strain in one direction compels counter-push or strain in another direction; hence opposed electricities, magnetisms, and polarization in general.

Gravitation may be considered the concurrent result of brief intertwisting of the physical poles; cohesion and crystallogenic energy represent more permanent interlocking. But chemical and physical combination are supposed to be alike in kind—the result of opposed, adapted mechanical energy. Chemical action in general produces more radical changes in the sensible properties of substances, because, taking the initiative, it sifts the atomic axes, and subsequent combinations are but in accommodation to these previous changes.

The hypothesis attempts to give a fairly adequate explanation of material changes; of the *how* and *why* of such changes.

The unlike elements of matter are supposed to be conditioned in special groups, but are essentially of the same type, and their changes are all in time and space only. There is held to be a higher type of atoms in the living

sentient, or "mind matter" group, which we know only through their active organisms. In these atoms, force is conditioned both by extension and by intensiveness, and not in time and space alone—as with simple matter, but in time and space and sentience.

Possible changes in sentience, emotion, may be nascent in these atoms just as complex motion is nascent in all uncombined or but little combined atoms. Complexity of action in molecule and larger mass against which any atom must react in equal measure and opposite directions, compels complexity in the atomic reactions, and in the higher type of atoms one phase of all these reactions represents changes in sentience-sensations, thoughts, volitions.

Molecular complexity sufficient to excite a pleasurable degree of feeling would tend instinctively to repeat itself; hence the rise of organisms. The organism is the sentient atoms everchanging active molecule; and organic growth is adapted to the more and more complex sentient states. Decadence means failure in such adjustments. Sentient changes vary all the way between the low sentient state of profound sleep and the most alert phase of self-consciousness, but they are all individual or atomic changes. This hypothesis claims to offer an explanation of the joint facts both of matter and of mind.

BACTERIA AND THEIR RELATIONS TO PLANT CULTURE.

By THOMAS TAYLOR, MICROSCOPIST, OF THE DEPARTMENT OF AGRICULTURE.

If we examine, under a high power of the microscope a small portion of the scum of a fermenting infusion of vegetable matter, numerous particles of a globular shape will be observed, measuring about one twenty-thousandth of an inch in diameter, uniform in size and shape, highly refractive and frequently found in gelatinous masses. These are known as micrococci, or spherical bacteria. Associated with them is generally found another description of germs of the same diameter, but of a rod-like shape, jointed and of various lengths. In common vegetable fermenting infusions they are seldom observed over .003 of an inch in length, and are frequently under .001 of an inch. They have generally an active motion, as seen under a high power (as have also the micrococci), and are known as rod-bacteria (from bacterion, a staff). Botanists of the present day assign both of these organisms to the division algae.

Many investigators believe that certain species of these organisms produce contagious fevers, but there certainly are other species which perform a most useful part in the economy of nature, and in many of our valued industries their active co-operation is absolutely necessary. It is well-known that they are the chief agents of fermentation and putrefaction, and it is to the decomposing power they thus exert, in conjunction with the action of the elements, that all organic bodies decay and restore to the earth soluble fertilizing salts, instead of the insoluble and therefore unavailable material of which, in their unchanged state, they are made up. There is high authority for stating that organic substances are not inherently unstable. Under suitable conditions they may remain for an indefinite period wholly unaltered. It is well-known that in some portions of the earth the carcasses of dead animals tend to dry up and become mummified. In the arctic region the remains of animals imbedded in ice are kept in perfect preservation for centuries. It is only under conditions more or less favorable to the existence and multiplication of the small organisms which produce fermentation and putrefaction that rapid decay takes place.

Without bacterian fermentation the compost heap of

* From the A. A. S., Cincinnati, 1881.

the farmer would remain valueless as plant food. The stubble and the dead grasses of our fields, and the fallen leaves, twigs, branches and trunks of trees would remain comparatively unchanged but for the chemical action excited by the same agency. Fish guano, and all unfermented organic fertilizers, must undergo bacterian fermentation or putrefaction after their application to the soil, or they will remain in a stable form, and their ammonia, locked up in the tissues of which it forms a component part, will fail to yield its return of profit to the farmer. It is asserted that the great nitre beds of India owe their origin to the action of microscopic germs, and the production of nitrate of lime by artificial means presents a similar instance of the results of bacterian action. In this last-named operation animal and vegetable matter combined with lime is laid out in great beds and left for a period of two years, or until fermentation and putrefaction, coupled with the action of the air, have produced nitric acid, when nitrate of lime is formed, to be subsequently converted into nitrate of potash.

Some of the most beautiful colors used in dyeing are produced by subjecting lichens to bacterian fermentation, and the fermentation of stable refuse yields an even heat, which is extensively utilized in the manufacture of white carbonate of lead, as well as in the cultivation of mushrooms and of various early vegetables. The value of the edible fungi thus produced, alone amounts in Europe, Asia and America to millions of dollars per annum. The utilization of bacteria and similar organisms in the operations of baking and brewing, and the production of wine and vinegar, is familiar to every household.

While bacterian fermentation or putrefaction is an essential part of the process which fits dead organic matter to become food for plants, the former appears to be an incidental source of one of the common practical difficulties encountered by the farmer and horticulturist, viz.: the tendency of soils to become sour. Some of the lower forms of fungi are denominated "acid formers," and the mode in which these act will, I think, illustrate the process by which sourness of soil is brought about. If we dissolve a little sugar in water, add a small quantity of yeast fungus, and subject the solution to a suitable temperature, fermentation ensues—the sugar is converted into alcohol and carbonic acid, and in process of time the alcohol is oxidized, becoming acetic acid. As the result of some late observations, I am convinced that a similar change often takes place during the progress of those fermentations of which bacteria are the agents, and that these organisms, though in a less distinctive sense, might also be called "acid formers." So far as my observation extends, solutions in which bacterian ferments are in active progress, invariably become acidulated, and I have also found that soils in which bacteria and micrococci are revealed by microscopic examination—and I find them in all soils of average fertility—give perceptible acid reactions when tested by litmus paper.

That acidity is so often produced in excessive quantities may be due in part to the character of the unmarketable substances left upon the land in the operations of agriculture, such as the stalks of corn, the stubble of the smaller cereals, decayed grasses, the fallen leaves and twigs of fruit trees, and the roots of field and garden plants in general. In all of these there is a preponderance of cellulose, which substance is resolvable successively into starch, dextrine and glucose, and from this last, as from the solution of sugar in the experiment above referred to, is ultimately produced acetic acid.

The neutralization of the excess of acid in the soil is not the least of the ends subserved by the use of lime and other alkalis in agriculture; but another means which contributes to keep its quantity within wholesome limits is thorough drainage. If the soil of potted plants be not watered with sufficient frequency and copiousness it soon becomes sour, and gardeners have learned by experience to leave at the top of each flower-pot a water

space of two inches, more or less, depending on the size of the pot. By filling this space with water as often as necessary the soil is kept sufficiently free from organic acids, which are washed out through the aperture below; and this is precisely similar to what takes place in any well-drained field.

I have already referred to the opinion that certain species of bacteria produce contagious fevers; but from what has been said above, it will be sufficiently apparent that this is by no means the chief function of this class of organisms. However great their baneful activity at times may be, their services to man and to organized existence in general are infinitely greater. Moreover, the former is but occasional and sporadic, while the latter is practically constant and universal. If the materials once used by the life principle in building up organic bodies could not be used over and over again for the same purpose, life must soon cease through the exhaustion of all that is capable of sustaining it. It is in that which has lived, but lives no longer, that life finds the greater part of its sustenance; but, as we have already seen, that vegetable life upon which all animal life ultimately depends can not use this sustenance in the form in which life left it. Before organic matter is available as plant food, it must be reduced almost to its primitive elements; and, as has been pointed out, its reduction is mainly effected through those processes of fermentation and putrefaction, in which bacteria appear to be the most active and important agents. Thus we find among those simple forms of life, which are supposed to have been the first to make their appearance on our planet, and to which, if we accept the theory of evolution, even the most complex of existing organisms owe their origin—an agent which, from the very inception of life upon the earth, has continuously performed a function without which the successive generations of plants and animals could not have existed; and stupendous as is its work, it is an agent so minute that twenty million individuals of its class might be inclosed within a globe small enough to pass through the eye of a cambric needle.

ANCIENT JAPANESE BRONZE BELLS.*

BY PROF. EDWARD S. MORSE.

Mr. Morse described the so-called Japanese Bronze Bells which are dug up in Japan. These bells had been described and figured by Prof. Monroe in the Proceedings of the New York Academy of Sciences. Mr. Kanda, an eminent Japanese archæologist, had questioned their being bells from their peculiar structure.

Mr. Morse had seen a number of bells of different kinds, some of considerable antiquity, but none of them approached these so-called bronze bells. Mr. Kanda had suggested that they were the ornaments which were formerly hung from the corners of pagoda roofs, but the fact that none of them showed signs of wear at the point of support, rendered this supposition untenable. Mr. John Robinson, of Salem, the author of a work on Ferns, had given the first suggestion as to the possible use of these objects. He has asked why they may not have been covers to incense burners. Curiously enough, old incense burners are dug up which have the same oval shape that a section of the bell shows. The bell has openings at the base and also at the sides and top, so that the smoke of burning incense might escape. It is quite evident that these objects are neither bells nor pagoda ornaments, and this suggestion of Mr. Robinson's may possibly lead to some clue regarding their origin.

ELECTRIC MOTIVE POWER FOR OMNIBUSES.—The Faure accumulators have been tried again by the Paris omnibus company on a tramway with a carriage arranged for the purpose. The experiment is said to have been highly successful.

*Read before the A. A. A. S., Cincinnati, 1881.